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Automatic Directional Screening System

The invention specifies a method of selective attenuation or obturation of light, in which the incident light (5) either has already been polarized or is polarized by additional means (14). The light so polarized passes through one or more electrically controlled liquid crystal elements (2; 22, 23, 24). By way of optical sensors (4), one or more characteristic properties of the light, for example intensity, are detected and converted into electrical signals. The electrical signals thus obtained are used to activate (9) the transilluminated liquid crystal elements. By virtue of elective preassignment of thresholds, the activation and hence an attenuation of light sets in only if light incident from certain directions exhibits special properties in sufficiently large part.

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- Description -

The present invention pertains to the field of optical instruments or devices serving for attenuation, filtering or partial screening of light.

The local attenuation or obturation of interfering light is important in many aspects of the arts and of everyday life. For a permanent attenuation, i.e. one not variable in its damping action, generally opaque shades are employed, or elements of translucent media such as glass or plastic, their transmissivity to light being reduced by tinting or partial reflection. Here a variation in degree of attenuation as a function of quantity and/or direction of the incident light is obtainable only by mechanical addition, removal or positioning of elements or shades, signifying a proportioning outlay of apparatus.

An alternative to this is offered by elements comprising optical media exhibiting a self-tinting action depending on the quantity of incident light (sun shades having this property have been commercially available for some years past). For these media, it is true, the self-tinting effect always occurs with some delay, possibly as much as some minutes. Rapid alternation in intensity of light cannot be compensated in this way. Besides, ordinarily the tinting can be varied only within a limited interval, so that no approach to complete shading is achieved in the case of very intense incidence of light. No dependence upon the direction or other properties of the incident

light than its intensity is available.

The object of the present invention, then, is to develop a device effecting a rapid reduction of illumination under incident light from preassigned directions, with no shades or other mechanical components, while in addition, besides the intensity of the light, other characteristic properties of the incident light may be used as parameters triggering the adjustment of attenuation.

The device according to the invention accomplishes this object by use of one or more optical sensors detecting one or more characteristic properties of the incident light as functions of direction and converting them into electrical signals. Electronic means pick up the electrical signals thus obtained and control one or more liquid crystal elements with an effect of altered transmissivity to light.

Other details and advantages of the present invention will be described in the following examples of preferred embodiments, with reference to the schematic drawings, in which

Fig. 1 represents a single liquid crystal element capable of being modified in its transmissivity to polarized light by electronic means,

Fig. 2 shows a similar liquid crystal element comprising zones, each with a different axis of orientation,

Fig. 3 represents a serial arrangement of liquid crystal elements, each with a different axis of orientation,

Fig. 4 shows a system for directional screening of reflected light, and

Fig. 5 shows a sensor for directional detection of light.

The present invention makes use of the polarizing effect of liquids capable of being electrically oriented. This principle has previously been applied for example in liquid crystal displays (LCDs). Polarized light is attenuated or transmitted according to its location in relation to the axis of orientation of the liquid crystal element.

Utilizing this principle, a system according to the invention may be constructed as sketched in Fig. 1. The device 1 for directional attenuation or obturation of light here consists of one or more single liquid crystal elements 2 whose optically active axis of orientation 8 can be varied electrically. Incident polarized light 5 of orientation 6 is attenuated in passing through the activated surface 7 of the element 2 so that only a reduced quantity of light 10 passes through. The directional effect is achieved in that certain properties of the incident light 5 are detected by one or more sensors 4, at least some of the sensors having a directional characteristic.

Fig. 5 represents a possible embodiment of a sensor. A lens 43 focuses the incident light 5 on a light-

sensitive element 42 shielded in a cylindrical housing 41 and generating electrical signals 44 under incident light. Other embodiments are possible as well, in which various light-sensitive elements may be employed, such as for example photoresistors, -diodes or -transistors. By use of suitable apparatus (e.g. matrix, CCD), a very precise analysis of the sources of light detected may be achieved.

The signals produced are picked up by an activating unit 3 activating the electrodes 9 required to orient the liquid crystal elements. With this arrangement, a shade may for example be built that will respond by automatic screening only to incidences of light within a defined angular interval.

At the same time, by use of suitable sensors, the attenuation may additionally be made dependent on the intensity, variation of intensity, spectral distribution or polarization properties of the incident light. When several sensors are used, not all need have a directional characteristic, so that still other components of light may be detected and used in combination with directional signals to activate the liquid crystal element or elements. The signal thresholds and control parameters in any instance for the activating unit 3 may be present as fixed quantities or preassigned variably by external adjusting means (not shown).

To achieve differential attenuation effects, a liquid crystal element may consist of separate individual activable zones, each having different axes of orientation. Such an apparatus 11 is shown in Fig. 2. Depending on the conditions of light detected, different zones or combinations of zones may be activated, so that the light 10 transmitted is differentially attenuated.

In another embodiment 12 (Fig. 3), several liquid crystal elements 22, 23, 24, which may be differently oriented, are traversed successively. With this embodiment, different efficiencies of attenuation of light may be attained as well.

Fig. 4 shows a special embodiment in which a reflecting surface 13 is placed following an appratus as previously described. Incident light 5 – here not polarized for example – is first polarized by the polar filter 14. Then it passes through one or more liquid crystal elements 2 as described and is thrown back by the reflecting surface 15, in which case, depending on the geometrical array of the several components, it may pass through the liquid crystal elements once more. Thus the intensity of the excident light may be varied through detection of the incident light by the sensor 4 and response of the following activating unit 3 in a directional manner.

The liquid crystal element 2 may be produced together with the reflective surface as a unit, its reverse side being for example directly mirrored, for example by vapor

deposition of metal.

With the device according to the invention, therefore, an automatic or controllable mirror system can be built, having controllable differential reflexivity for light at different angles of incidence. In this arrangement also, additional sensors, which may or may not be directional, may be utilized for activation (not shown). An example of an application would be a rear-view mirror exhibiting an automatic diminution of reflexivity as soon as the position and relative intensity of the impingeing light can trigger an obturation.

The devices according to the invention may (as represented for example in Fig. 4) be employed without restriction for unpolarized light also, incident light being simply polarized by means of a polar filter 14 placed in front. Other filters, for example to suppress certain wavelengths of light, may likewise be additionally employed.

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- Claims -

1. Device (1, 11, 12) for attenuation or obturation of light, in which the light (5) to be attenuated either has been already polarized or is polarized by suitable means (14), and the light so polarized passes through at least one electronically variable liquid crystal element (2; 22, 23, 24), characterized
in that at least one optical sensor (4) is present, which detects one or more characteristic properties of the incident light as functions of direction and converts them into electrical signals, and
in that one or more electronic means (3) pick up the electrical signals thus obtained and activate the transilluminated liquid crystal element or elements (2; 22, 23, 24) with respect to a varied transmissivity to light.

2. Device according to claim 1, in which the electronic means (3) activate one or more liquid crystal elements according as the signals detected by one or more sensors exceed or fall short of preassigned threshold quantities.

3. Device according to claim 1 or 2, in which the additional means (14) for polarization consist of at least one polarizing filter or at least one electrically variable liquid crystal element.

4. Device according to any of the preceding claims, in which the amount of attenuation of light can be varied by adjusting the angle between the direction of polarization (6) of the polarized light and the axis of orientation (8)

of at least one electrically variable liquid crystal element.

5. Device according to any of the preceding claims, in which the amount of attenuation of light can be varied by activating one or more liquid crystal elements (2; 22, 23, 24) whose axes of orientation (8) make different angles with the direction of polarization (6) of the polarized light.

6. Device according to any of the preceding claims, in which at least one liquid crystal element is divided into single zones, electrically activable individually.

7. Device according to any of the preceding claims, in which the directionally detected properties of the incident light are intensity, fluctuations of intensity, polarization, or spectral distribution.

8. Device according to any of the preceding claims, in which spectral components of the incident light are suppressed by additional means.

9. Device (13) for selective reflection of light, in which an at least partially reflecting surface (15) is combined with a device according to any of the preceding claims.

10. Device according to any of the preceding claims, comprising additional optical sensors detecting the conditions of light without restriction to particular directions, their signals being picked up additionally as parameters for adjusting the electronic means.

11. Use of a device according to any of the preceding

claims for directional obturation, attenuation or reflection of light.

With 3 sheets of drawings.